CONTENTS TO VOLUME 35

Part 1 16 January 1969

Solitary waves in trapezoidal channels. D. H. Peregrine *page* 1

Laboratory investigation of non-steady penetrative convection. J. W. Deardorff, G. E. Willis and D. K. Lilly 7

Centrifugally driven thermal convection in a rotating cylinder. G. M. Homsy and J. L. Hudson 33

A point explosion in a cold exponential atmosphere. Dallas D. Laumbach and Ronald F. Probstein 53

Large-amplitude motions of a liquid–vapour interface in an accelerating container. L. M. Perko 77

On the instability of viscous flow in a rapidly rotating pipe. T. J. Pedley 97

The degree of knottedness of tangled vortex lines. H. K. Moffatt 117

Progressive internal waves on slopes. Carl Wunsch 131

An analysis of second-order effects on laminar boundary-layer flow. M. Honda and Y. Kiyokawa 145

Measurement of the relaxation frequency of the asymmetric stretching mode of carbon dioxide. J. P. Hodgson and R. J. Hine 171

Linear theory of the circulation of a stratified ocean. Joseph Pedlosky 185

Reviews

General Mechanics, by Henri Cabannes 206

Mixing: Theory and Practice, Vol. 1, *edited by V. W. Uhl and J. B. Gray* 207

Part 2 3 February 1969

Collective instability of salt fingers. Melvin E. Stern 209

Axisymmetric internal waves generated by a travelling oscillating body. T. N. Stevenson 219

On the criteria for reverse transition in a two-dimensional boundary layer flow. M. A. Badri Narayanan and V. Ramjee 225

Effect of modulation on the onset of thermal convection. Giulio Venezian 243

Rossby wave packet interactions. A. C. Newell 255

Wave-number selection at finite amplitude in rotating Couette flow. H. A. Snyder 273

Acoustic energy flux from shock-turbulence interaction. H. S. Ribner 299

XUM

The effect of pressure gradient on the law of the wall in turbulent flow. HENRY McDONALD *page* 311

Change in wave-form and mean flow associated with wavelength variations in rotating Couette flow. Part 1. H. A. SNYDER 337

Velocity gradients at the wall for flow around a cylinder at Reynolds numbers from 5×10^3 to 10^5. JAIME S. SON and THOMAS J. HANRATTY 353

Numerical solution for the flow around a cylinder at Reynolds numbers of 40, 200 and 500. JAIME S. SON and THOMAS J. HANRATTY 369

A note on reverse transition. P. BRADSHAW 387

The diffraction accompanying the regular reflexion of a plane obliquely impinging shock wave from the walls of an obtuse wedge. S. M. TER-MINASSIANTS 391

Experimental studies in magneto-fluid dynamics: flow over a sphere with a cylindrical afterbody. T. MAXWORTHY 411

PART 3 20 FEBRUARY 1969

The temporal development of a model of high Rayleigh number convection. J. W. ELDER 417

The effect of buoyancy forces on the boundary-layer flow over a semi-infinite vertical flat plate in a uniform free stream. J. H. MERKIN 439

The three-dimensional detonation polar and an application to spinning detonation. A. K. MACPHERSON 451

Lee waves in a stratified flow. Part 3. Semi-elliptical obstacle. HERBERT E. HUPPERT and JOHN W. MILES 481

Lee waves in a stratified flow. Part 4. Perturbation approximations. JOHN W. MILES and HERBERT E. HUPPERT 497

On the wavelength of convective motions. E. L. KOSCHMIEDER 527

Mixed region collapse with internal wave generation in a density-stratified medium. JIN WU 531

A proof that convection in a porous vertical slab is stable. A. E. GILL 545

An analytical and experimental investigation of the trajectories of particles entertained by the gas flow in nozzles. JOHN H. NEILSON and ALASTAIR GILCHRIST 549

On fluctuating flow of an elastico-viscous fluid past an infinite plate with variable suction. V. M. SOUNDALGEKAR and PRATAP PURI 561

The structure of shock-waves in gas mixtures. EDWARD GOLDMAN and LAWRENCE SIROVICH 575

Mass flow rate for nearly-free molecular slit flow. J. DANIEL STEWART 599

Transition from laminar convection to thermal turbulence in a rotating fluid layer. G. KÜPPERS and D. LORTZ 609

REVIEWS

An Introduction to Fluid Dynamics, by G. K. Batchelor 621

Laminar Boundary Layer Theory, by H. L. Evans 623

PART 4 10 MARCH 1969

Experiments on the generation of small water waves by wind. E. J. PLATE, P. C. CHANG and G. M. HIDY *page* 625

Response of gravity water waves to wind excitation. JAMES B. BOLE and EN YUN HSU 657

An experimental investigation of thermosolutal convection at marginal stability. T. G. L. SHIRTCLIFFE 677

An electric arc in a transverse magnetic field: a theory for low power gradient. W. T. LORD 689

Gas diffusion from ascending gas bubbles. PAUL H. LEBLOND 711

The fluid mechanics of the aortic valve. B. J. BELLHOUSE and L. TALBOT 721

The measurement of skin friction in turbulent boundary layers with adverse pressure gradients. K. C. BROWN and P. N. JOUBERT 737

Pathological oscillations of a rotating fluid. K. STEWARTSON and J. A. RICKARD 759

Instabilities of a buoyancy-driven system. A. E. GILL and A. DAVEY 775

Inviscid reacting flow near a stagnation point. RAUL CONTI and MILTON VAN DYKE 799

The generation of continental shelf waves. J. K. ADAMS and V. T. BUCHWALD 815

CORRIGENDA 827

INDEX TO VOLUME 35 830

INDEX

ADAMS, J. K. & BUCHWALD, V. T. The generation of continental shelf waves, 815

BELLHOUSE, B. J. & TALBOT, L. The fluid mechanics of the aortic valve, 721

BOLE, JAMES, B. & HSU, EN YUN. Response of gravity water waves to wind excitation, 657

BRADSHAW, P. A note on reverse transition, 387

BROWN, K. C. & JOUBERT, P. N. The measurement of skin friction in turbulent boundary layers with adverse pressure gradients, 737

BUCHWALD, V. T. *See* ADAMS, J. K. & BUCHWALD, V. T.

CHANG, P. C. *See* PLATE, E. J., CHANG, P. C. & HIDY, G. M.

CONTI, RAUL & VAN DYKE, MILTON. Inviscid reacting flow near a stagnation point, 799

DAVEY, A. *See* GILL, A. E. & DAVEY, A.

DEARDORF, J. W., WILLIS, G. E. & LILLY, D. K. Laboratory investigation of non-steady penetrative convection, 7

ELDER, J. W. The temporal development of a model of high Rayleigh number convection, 417

GILCHRIST, ALASTAIR. *See* NEILSON, JOHN H. & GILCHRIST, ALASTAIR

GILL, A. E. A proof that convection in a porous vertical slab is stable, 545

GILL, A. E. & DAVEY, A. Instabilities of a buoyancy-driven system, 775

GOLDMAN, EDWARD & SIROVICH, LAWRENCE. The structure of shock-waves in gas mixtures, 575

HANRATTY, THOMAS J. *See* SON, JAIME S. & HANRATTY, THOMAS J.

HIDY, G. M. *See* PLATE, E. J., CHANG, P. C. & HIDY, G. M.

HINE, R. J. *See* HODGSON, J. P. & HINE, R. J.

HODGSON, J. P. & HINE, R. J. Measurement of the relaxation frequency of the asymmetric stretching mode of carbon dioxide, 171

HOMSY, G. M. & HUDSON, J. L. Centrifugally driven thermal convection in a rotating cylinder, 33

HONDA, M. & KIYOKAWA, Y. An analysis of second-order effects on laminar boundary-layer flow, 145

HSU, EN YUN. *See* BOLE, JAMES B. & HSU, EN YUN

HUDSON, J. L. *See* HOMSBY, G. M. & HUDSON, J. L.

HUPPERT, HERBERT E. & MILES, JOHN W. Lee waves in a stratified flow. Part 3. Semi-elliptical obstacle, 481

HUPPERT, HERBERT E. *See* MILES, JOHN W. & HUPPERT, HERBERT E.

JOUBERT, P. N. *See* BROWN, K. C. & JOUBERT, P. N.

KIYOKAWA, Y. *See* HONDA, M. & KIYOKAWA, Y.

KOSCHMIEDER, E. L. On the wavelength of convective motions, 527

KÜPPERS, G. & LORTZ, D. Transition from laminar convection to thermal turbulence in a rotating fluid layer, 609

LAUMBACH, DALLAS D. & PROBSTEIN, RONALD F. A point explosion in a cold exponential atmosphere, 53

LEBLOND, PAUL H. Gas diffusion from ascending gas bubbles, 711

LILLY, D. K. *See* DEARDORFF, J. W., WILLIS, G. E. & LILLY, D. K.

XUM

LORD, W. T. An electric arc in a transverse magnetic field: a theory for low power gradient, 689

LORTZ, D. *See* KÜPPERS, G. & LORTZ, D.

MCDONALD, HENRY. The effect of pressure gradient on the law of the wall in turbulent flow, 311

MACPHERSON, A. K. The three-dimensional detonation polar and an application to spinning detonation, 451

MAXWORTHY, T. Experimental studies in magneto-fluid dynamics: flow over a sphere with a cylindrical afterbody, 411

MERKIN, J. H. The effect of buoyancy forces on the boundary-layer flow over a semi-infinite vertical flat plate in a uniform free stream, 439

MILES, JOHN W. & HUPPERT, HERBERT E. Lee waves in a stratified flow. Part 4. Perturbation approximations, 497

MILES, JOHN W. *See* HUPPERT, HERBERT E. & MILES, JOHN W.

MOFFATT, H. K. The degree of knottedness of tangled vortex lines, 117

NARAYANAN, M. A. BADRI & RAMJEE, V. On the criteria for reverse transition in a two-dimensional boundary layer flow, 225

NEILSON, JOHN H. & GILCHRIST, ALASTAIR. An analytical and experimental investigation of the trajectories of particles entrained by the gas flow in nozzles, 549

NEWELL, A. C. Rossby wave packet interactions, 255

PEDLEY, T. J. On the instability of viscous flow in a rapidly rotating pipe, 97

PEDLOSKY, JOSEPH. Linear theory of the circulation of a statified ocean, 185

PEREGRINE, D. H. Solitary waves in trapezoidal channels, 1

PERKO, L. M. Large-amplitude motions of a liquid–vapour interface in an accelerating container, 77

PLATE, E. J., CHANG, P. C. & HIDY, G. M. Experiments on the generation of small water waves by wind, 625

PROBSTEIN, RONALD F. *See* LAUMBACH, DALLAS D. & PROBSTEIN, RONALD F.

PURI, PRATAP. *See* SOUNDALGEKAR, V. M. & PURI, PRATAP

RAMJEE, V. *See* NARAYANAN, M. A. BADRI & RAMJEE, V.

RIBNER, H. S. Acoustic energy flux from shock-turbulence interaction, 299

RICKARD, J. A. *See* STEWARTSON, K. & RICKARD, J. A.

SHIRTCLIFFE, T. G. L. An experimental investigation of thermosolutal convection at marginal stability, 677

SIROVICH, LAWRENCE. *See* GOLDMAN, EDWARD & SIROVICH, LAWRENCE

SNYDER, H. A. Wave-number selection at finite amplitude in rotating Couette flow, 273

SNYDER, H. A. Change in wave-form and mean flow associated with wavelength variations in rotating Couette flow. Part 1, 337

SON, JAIME S. & HANRATTY, THOMAS J. Velocity gradients at the wall for flow around a cylinder at Reynolds numbers from 5×10^3 to 10^5, 353

SON, JAIME S. & HANRATTY, THOMAS J. Numerical solution for the flow around a cylinder at Reynolds numbers of 40, 200 and 500, 369

SOUNDALGEKAR, V. M. & PURI, PRATAP. On fluctuating flow of an elastico-viscous fluid past an infinite plate with variable suction, 561

STERN, MELVIN E. Collective instability of salt fingers, 209

STEVENSON, T. N. Axisymmetric internal waves generated by a travelling oscillating body, 219

STEWART, J. DANIEL. Mass flow rate for nearly-free molecular slit flow, 599

XUM

STEWARTSON, K. & RICKARD, J. A. Pathological oscillations of a rotating fluid, 759

TALBOT, L. *See* BELLHOUSE, B. J. & TALBOT, L.

TER-MINASSIANTS, S. M. The diffraction accompanying the regular reflexion of a plane obliquely impinging shock wave from the walls of an obtuse wedge, 391

VAN DYKE, MILTON. *See* CONTI, RAUL & VAN DYKE, MILTON

VENEZIAN, GIULIO. Effect of modulation on the onset of thermal convection, 243

WILLIS, G. E. *See* DEARDOFF, J. W., WILLIS, G. E. & LILLY, D. K.

WU, JIN. Mixed region collapse with internal wave generation in a density-stratified medium, 531

WUNSCH, CARL. Progressive internal waves on slopes, 131

REVIEWS

General Mechanics, by Henri Cabannes, 206

Mixing: Theory and Practice, Vol. 1, *edited by V. W. Uhl and J. B. Gray*, 207

An Introduction to Fluid Dynamics, by G. K. Batchelor, 621

Laminar Boundary Layer Theory, by H. L. Evans, 623

XUM

JOURNAL OF FLUID MECHANICS

VOLUME 36
1969

CAMBRIDGE
AT THE UNIVERSITY PRESS
1969

XUM

PUBLISHED BY
THE SYNDICS OF THE CAMBRIDGE UNIVERSITY PRESS
Bentley House, 200 Euston Road, London, N.W. 1
American Branch: 32 East 57th Street, New York, N.Y. 10022

Printed in Great Britain at the University Printing House, Cambridge

XUM

CONTENTS TO VOLUME 36

PART 1 27 MARCH 1969

Stability of natural convection in a vertical slot. CHARLES M. VEST and VEDAT S. ARPACI *page* 1

An exact solution for a diffusive flow on a porous medium. E. J. LIST 17

Experiments on natural convection in enclosures with localized heating from below. K. E. TORRANCE, L. ORLOFF and J. A. ROCKETT 21

Numerical study of natural convection in an enclosure with localized heating from below—creeping flow to the onset of laminar instability. K. E. TORRANCE and J. A. ROCKETT 33

Cavities formed on liquid surfaces by impinging gaseous jets. FRANK R. CHESLAK, J. ARTHUR NICHOLLS and MARTIN SICHEL 55

Wave diffraction in a two-fluid system. R. E. KELLY 65

A class of solutions for steady stratified flows. CHIA-SHUN YIH 75

Heat transfer and transition to turbulence in the shock-induced boundary layer on a semi-infinite flat plate. W. R. DAVIES and L. BERNSTEIN 87

Finite-amplitude stability of a parallel flow with a free surface. S. P. LIN 113

The two-dimensional flow of a stratified fluid over an obstacle. RUSS E. DAVIS 127

Boundary-value problems in the kinetic theory of gases. Part 1. Slip flow. M. M. R. WILLIAMS 145

A flow reversal due to edge effects. D. F. GRIFFITHS, D. T. JONES and K. WALTERS 161

The analogy between streamline curvature and buoyancy in turbulent shear flow. P. BRADSHAW 177

Hydromagnetic stability of dissipative flow between rotating permeable cylinders. Part 2. Oscillatory critical modes and asymptotic results. TIEN SUN CHANG and WALTER K. SARTORY 193

REVIEWS

Fluid Mechanics and Singular Perturbations: A Collection of Papers by Saul Kaplun, edited by P. Lagerstrom, L. N. Howard and C.-S. Liu 207

PART 2 14 APRIL 1969

The stability of Poiseuille flow in a pipe. A. DAVEY and P. G. DRAZIN 209

The viscous vortex induced by a sink on the axis of a circulating fluid in the presence of a plane free surface. T. J. PEDLEY 219

Buoyancy-driven convection in cylindrical geometrics. S. F. Liang, A. Vidal and Andreas Acrivos *page* 239

On the non-linear interaction of inertial modes. H. P. Greenspan 257

The lee-wave régime for a slender body in a rotating flow. John W. Miles 265

Some aspects of time-dependent motion of a stratified rotating fluid. Gösta Walin 289

A study of Bénard convection with and without rotation. H. T. Rossby 309

On the high Reynolds number flow over a wavy boundary. Russ E. Davis 337

Numerical studies of the laminar boundary layer for Mach numbers up to 15. Henry A. Fitzhugh 347

A computational method for the flow through non-uniform gauzes: the general two-dimensional case. J. T. Turner 367

The onset of cellular convection in a fluid layer with time-dependent density gradients. L. M. Blair and J. A. Quinn 385

Axially symmetric motion of a stratified, rotating fluid in a spherical annulus of narrow gap. J. Pedlosky 401

Part 3 1 May 1969

Aerodynamic lift and moment fluctuations of a sphere. W. W. Willmarth and R. L. Enlow 417

Non-linear internal gravity waves in a slightly stratified atmosphere. P. G. Drazin 433

An experimental investigation of disturbance amplification in external laminar natural convection flow. R. P. Dring and B. Gebhart 447

Instability and river channels. R. A. Callander 465

Report on the AFOSR-IFP-Stanford conference on computation of turbulent boundary layers. S. J. Kline, H. K. Moffatt and M. V. Morkovin 481

The turbulent boundary layer in a corner. G. M. Bragg 485

Two-dimensional internal waves generated by a travelling oscillating cylinder. T. N. Stevenson and N. H. Thomas 505

Impulsively started oscillations in a rotating stratified fluid. Myrl C. Hendershott 513

Fluctuating turbulent stresses in the noise-producing region of a jet. Ian S. F. Jones 529

The Boltzmann collision integrals for a combination of Maxwellians. S. M. Deshpande and R. Narasimha 545

Minimum error solutions of the Boltzmann equation for shock structure. R. Narasimha and S. M. Deshpande 555

The structure of rarefied gas flows past simple aerodynamic shapes. G. A. Bird *page* 571

Condensation on and evaporation from droplets by a moment method. Robert E. Sampson and George S. Springer 577

Sound generation by turbulent two-phase flow. D. G. Crighton and J. E. Ffowcs Williams 585

Abiadatic transverse modes in a uniformly rotating fluid. C. Sozou 605

Overstability of a viscoelastic fluid layer heated from below. Charles M. Vest and Vedat S. Arpaci 613

Part 4 19 May 1969

Laminar convection cells at high Rayleigh number. P. Wesseling 625

Mixing shocks in two-phase flow. Jan H. Witte 639

The emission of internal waves by vibrating cylinders. D. G. Hurley 657

Neutral eigensolutions of the stability equation for stratified shear flow. S. A. Thorpe 673

The stability of plane Couette flow with viscosity stratification. Alex D. D. Craik 685

The initial ionization of hydrogen in a strong shock wave. A. N. Belozerov and R. M. Measures 695

Eigenvalue bounds for the Orr–Sommerfeld equation. Part 2. Daniel D. Joseph 721

Lifting-surface theory for cascade of blades in subsonic shear flow. Masanobu Namba 735

Theory of transonic shear flow past a thin aerofoil. Masanobu Namba 759

On the mean motion induced by internal gravity waves. Francis P. Bretherton 785

On some problems of similarity flow of fluid with a free surface. Z. N. Dobrovol'skaya 805

Index to Volume 36 830

XUM

INDEX

ACRIVOS, ANDREAS. *See* LIANG, S. F., VIDAL, A. & ACRIVOS, ANDREAS

ARPACI, VEDAT S. *See* VEST, CHARLES M. & ARPACI, VEDAT S.

BELOZEROV, A. N. & MEASURES, R. M. The initial ionization of hydrogen in a strong shock wave, 695

BERNSTEIN, L. *See* DAVIES, W. R. & BERNSTEIN, L.

BIRD, G. A. The structure of rarefied gas flows past simple aerodynamic shapes, 571

BLAIR, L. M. & QUINN, J. A. The onset of cellular convection in a fluid layer with time-dependent density gradients, 385

BRADSHAW, P. The analogy between streamline curvature and buoyancy in turbulent shear flow, 177

BRAGG, G. M. The turbulent boundary layer in a corner, 485

BRETHERTON, FRANCIS P. On the mean motion induced by internal gravity waves, 785

CALLANDER, R. A. Instability and river channels, 465

CHANG, TIEN SUN & SARTORY, WALTER K. Hydromagnetic stability of dissipative flow between rotating permeable cylinders. Part 2. Oscillatory critical modes and asymptotic results, 193

CHESLAK, FRANK R., NICHOLLS, J. ARTHUR & SICHEL, MARTIN. Cavities formed on liquid surfaces by impinging gaseous jets, 55

CRAIK, ALEX D. D. The stability of plane Couette flow with viscosity stratification, 685

CRIGHTON, D. G. & FFOWCS WILLIAMS, J. E. Sound generation by turbulent two-phase flow, 585

DAVEY, A. & DRAZIN, P. G. The stability of Poiseuille flow in a pipe, 209

DAVIES, W. R. & BERNSTEIN, L. Heat transfer and transition to turbulence in the shock-induced boundary layer on a semi-infinite flat plate, 87

DAVIS, RUSS E. The two-dimensional flow of a stratified fluid over an obstacle, 127

DAVIS, RUSS E. On the high Reynolds number flow over a wavy boundary, 337

DESHPANDE, S. M. & NARASIMHA, R. The Boltzmann collision integrals for a combination of Maxwellians, 545

DESHPANDE, S. M. *See* NARASIMHA, R. & DESHPANDE, S. M.

DOBROVOL'SKAYA, Z. N. On some problems of similarity flow of fluid with a free surface, 805

DRAZIN, P. G. Non-linear internal gravity waves in a slightly stratified atmosphere, 433

DRAZIN, P. G. *See* DAVEY, A. & DRAZIN, P. G.

DRING, R. P. & GEBHART, B. An experimental investigation of disturbance amplification in external laminar natural convection flow, 447

ENLOW, R. L. *See* WILLMARTH, W. W. & ENLOW, R. L.

FFOWCS WILLIAMS, J. E. *See* CRIGHTON, D. G. & FFOWCS WILLIAMS, J E.

FITZHUGH, HENRY A. Numerical studies of the laminar boundary layer for Mach numbers up to 15, 347

GEBHART, B. *See* DRING, R. P. & GEBHART, B.

GREENSPAN, H. P. On the non-linear interaction of inertial modes, 257

GRIFFITHS, D. F., JONES, D. T. & WALTERS, K. A flow reversal due to edge effects, 161

HENDERSHOTT, MYRL C. Impulsively started oscillations in a rotating stratified fluid, 513

XUM

HURLEY, D. G. The emission of internal waves by vibrating cylinders, 657

JONES, D. T. *See* GRIFFITHS, D. F., JONES, D. T. & WALTERS, K.

JONES, IAN S. F. Fluctuating turbulent stresses in the noise-producing region of a jet, 529

JOSEPH, DANIEL D. Eigenvalue bounds for the Orr–Sommerfeld equation. Part 2, 721

KELLY, R. E. Wave diffraction in a two-fluid system, 65

KLINE, S. J., MOFFATT, H. K. & MORKOVIN, M. V. Report on the AFOSR-IFP-Stanford conference on computation of turbulent boundary layers, 481

LIANG, S. F., VIDAL, A. & ACRIVOS, ANDREAS. Buoyancy-driven convection in cylindrical geometries, 239

LIN, S. P. Finite-amplitude stability of a parallel flow with a free surface, 113

LIST, E. J. An exact solution for a diffusive flow in a porous medium, 17

MEASURES, R. M. *See* BELOZEROV, A. N. & MEASURES, R. M.

MILES, JOHN W. The lee-wave régime for a slender body in a rotating flow, 265

MOFFATT, H. K. *See* KLINE, S. J., MOFFATT, H. K. & MORKOVIN, M. V.

MORKOVIN, M. V. *See* KLINE, S. J., MOFFATT, H. K. & MORKOVIN, M. V.

NAMBA, MASANOBU. Lifting-surface theory for cascade of blades in subsonic shear flow, 735

NAMBA, MASANOBU. Theory of transonic shear flow past a thin aerofoil, 759

NARASIMHA, R. & DESHPANDE, S. M. Minimum error solutions of the Boltzmann equation for shock structure, 555

NARASIMHA, R. *See* DESHPANDE, S. M. & NARASIMHA, R.

NICHOLLS, J. ARTHUR. *See* CHESLAK, FRANK R., NICHOLLS, J. ARTHUR & SICHEL, MARTIN

ORLOFF, L. *See* TORRANCE, K. E., ORLOFF, L. & ROCKETT, J. A.

PEDLEY, T. J. The viscous vortex induced by a sink on the axis of a circulating fluid in the presence of a plane free surface, 219

PEDLOSKY, J. Axially symmetric motion of a stratified, rotating fluid in a spherical annulus of narrow gap, 401

QUINN, J. A. *See* BLAIR, L. M. & QUINN, J. A.

ROCKETT, J. A. *See* TORRANCE, K. E., ORLOFF, L. & ROCKETT, J. A. *and* TORRANCE, K. E. & ROCKETT, J. A.

ROSSBY, H. T. A study of Bénard convection with and without rotation, 309

SAMPSON, ROBERT E. & SPRINGER, GEORGE S. Condensation on and evaporation from droplets by a moment method, 577

SARTORY, WALTER K. *See* CHANG, TIEN SUN & SARTORY, WALTER K.

SICHEL, MARTIN. *See* CHESLAK, FRANK R., NICHOLLS, J. ARTHUR & SICHEL, MARTIN

SOZOU, C. Adiabatic transverse modes in a uniformly rotating fluid, 605

SPRINGER, GEORGE S. *See* SAMPSON, ROBERT E. & SPRINGER, GEORGE E.

STEVENSON, T. N. & THOMAS, N. H. Two-dimensional internal waves generated by a travelling oscillating cylinder, 505

THOMAS, N. H. *See* STEVENSON, T. N. & THOMAS, N. H.

THORPE, S. A. Neutral eigensolutions of the stability equation for stratified shear flow, 673

TORRANCE, K. E., ORLOFF, L. & ROCKETT, J. A. Experiments on natural convection in enclosures with localized heating from below, 21

TORRANCE, K. E. & ROCKETT, J. A. Numerical study of natural convection in an enclosure with localized heating from below—creeping flow to the onset of laminar instability, 33

TURNER, J. T. A computational method for the flow through non-uniform gauzes: the general two-dimensional case. 367

XUM

VEST, CHARLES M. & ARPACI, VEDAT S. Stability of natural convection in a vertical slot, 1

VEST, CHARLES M. & ARPACI, VEDAT S. Overstability of a viscoelastic fluid layer heated from below, 613

VIDAL, A. *See* LIANG, S. F., VIDAL, A. & ACRIVOS, ANDREAS

WALIN, GÖSTA. Some aspects of time-dependent motion of a stratified rotating fluid, 289

WALTERS, K. *See* GRIFFITHS, D. F., JONES, D. T. & WALTERS, K.

WESSELING, P. Laminar convection cells at high Rayleigh number, 625

WILLIAMS, M. M. R. Boundary-value problems in the kinetic theory of gases. Part 1. Slip flow, 145

WILLMARTH, W. W. & ENLOW, R. L. Aerodynamic lift and moment fluctuations of a sphere, 417

WITTE, JAN H. Mixing shocks in two-phase flow, 639

YIH, CHIA-SHUN. A class of solutions for steady stratified flows, 75

REVIEWS

Fluid Mechanics and Singular Perturbations: A Collection of Papers by Saul Kaplun, edited by P. Lagerstrom, L. N. Howard and C.-S. Liu, 207

XUM

JOURNAL OF FLUID MECHANICS

VOLUME 37
1969

CAMBRIDGE
AT THE UNIVERSITY PRESS
1969

XUM

PUBLISHED BY
THE SYNDICS OF THE CAMBRIDGE UNIVERSITY PRESS

Bentley House, 200 Euston Road, London, N.W. 1
American Branch: 32 East 57th Street, New York, N.Y. 10022

Printed in Great Britain at the University Printing House, Cambridge

CONTENTS TO VOLUME 37

Part 1 5 June 1969

A visual investigation of the wall region in turbulent flow. E. R. Corino and Robert S. Brodkey *page* 1

Non-linear wave propagation in a relaxing gas. P. A. Blythe 31

Turbulent buoyant convection from a source in a confined region. W. D. Baines and J. S. Turner 51

The effect of initial conditions and lateral boundaries on convection. Theodore D. Foster 81

Calculation of incompressible flow past a circular cylinder at moderate Reynolds numbers. Robert Leigh Underwood 95

The dynamic balances of dissolved air and heat in natural cavity flows. C. Brennen 115

Turbulent boundary-layer flow on a rotating disk. T-S. Cham and M. R. Head 129

An experimental investigation of the composition of jet noise. G. Krishnappa and G. T. Csanady 149

Slow oscillations in an ocean of varying depth. Part 1. Abrupt topography. P. B. Rhines 161

Slow oscillations in an ocean of varying depth. Part 2. Islands and seamounts. P. B. Rhines 191

Review

Loose Boundary Hydraulics, by A. J. Raudkivi 207

Part 2 23 June 1969

Hartmann flow in annular channels. Part 2. Numerical solutions for low to moderate Hartmann numbers. C. J. Apelt 209

On the reflexion of wave characteristics from rough surfaces. M. S. Longuet-Higgins 231

Longitudinal vortices in natural convection flow on inclined plates. E. M. Sparrow and R. B. Husar 251

Spherical cap bubbles with laminar wakes. Jean-Yves Parlange 257

Effects of sound on separated flows. Jon A. Peterka and Peter D. Richardson 265

On thermohaline convection with linear gradients. P. G. Baines and A. E. Gill 289

Axisymmetric inertial oscillations of a fluid in a rotating spherical container. Keith D. Aldridge and Alar Toomre 307

Experiments on shock stand-off distance in non-equilibrium flow. Peter P. Wegener and George Buzyna *page* 325

The flow induced by torsional oscillations of infinite planes. A. F. Jones and S. Rosenblat 337

On the structure of a class of aerothermodynamic shocks. P. A. Blythe, D. G. Petty, D. A. Schofield and J. L. Wilson 349

Variations in filtration velocity due to random large-scale fluctuations of porosity. Yu. A. Buyevich, A. I. Leonov and V. M. Safrai 371

Rough wall turbulent boundary layers. A. E. Perry, W. H. Schofield and P. N. Joubert 383

Review

Mécanique des fluides, by E. A. Brun, A. Martinot-Lagarde and J. Mathieu 414

Part 3 10 July 1969

On the generation of double Kelvin waves. L. A. Mysak 417

The motion of a fluid in a cylindrical container with a free surface following vertical impact. Jerome H. Milgram 435

A law of the wall for compressible turbulent boundary layers with air injection. L. C. Squire 449

On Howard's upper bound for heat transport by turbulent convection. F. H. Busse 457

Jets from two-dimensional symmetric nozzles of arbitrary shape. Bruce E. Larock 479

Smoke observations of the formation of a Kármán vortex street. M. M. Zdravkovich 491

Self-similar piston problems with radiative heat transfer. J. B. Helliwell 497

Initial propagation of impulsively generated converging cylindrical and spherical shock waves. Glen G. Bach and John H. Lee 513

Distortion of sonic bangs by atmospheric turbulence. S. C. Crow 529

Particle collision efficiencies for a sphere. D. H. Michael and P. W. Norey 565

On vortex shedding from a circular cylinder in the critical Reynolds number régime. P. W. Bearman 577

Velocity and pressure distributions in the aortic valve. B. J. Bellhouse 587

The deformation of a drop in a general time-dependent fluid flow. R. G. Cox 601

Part 4 28 July 1969

The calculation of three-dimensional turbulent boundary layers in incompressible flow. J. F. Nash 625

On the penetration of a turbulent layer into stratified fluid. H. KATO and O. M. PHILLIPS *page* 643

Stokes flow around a circular cylindrical post confined between two parallel plates. J. S. LEE and Y. C. FUNG 657

A numerical solution of axisymmetric cavity flows. CHRISTOPHER BRENNEN 671

Spin down problem of rotating stratified fluid in thermally insulated circular cylinders. TAKEO SAKURAI 689

Some aspects of turbulence measurement in liquid mercury using cylindrical quartz-insulated hot-film sensors. D. G. MALCOLM 701

A note on the damping and oscillations of a fluid drop moving in another fluid. S. V. SUBRAMANYAM 715

Numerical integration of the three-dimensional Navier–Stokes equations for incompressible flow. GARETH P. WILLIAMS 727

On the flow past a sphere at low Reynolds number. W. CHESTER and D. R. BREACH 751

The interaction of internal waves with an unsteady non-uniform current. YEE-CHANG WANG 761

On the trappings of long-period waves round islands. M. S. LONGUET-HIGGINS 773

Free convection at low Prandtl numbers. H. K. KUIKEN 785

Peristaltic pumping with long wavelengths at low Reynolds number. A. H. SHAPIRO, M. Y. JAFFRIN and S. L. WEINBERG 799

REVIEWS

SHORTER NOTICES

Introduction to the Hydrodynamics of Porous Bodies, by St I. Gheorghita 826

Clear Air Turbulence, by N. K. Vinnichenko, N. Z. Pinus, S. M. Shmeter and G. N. Shur 826

Dynamics of Elastic Containers Partially Filled with Liquid, by I. M. Rapoport 826

Directory of Fire Research in the United States, 1965–1967 826

Thermodynamic Tables in S.I. (Metric) Units, by R. W. Haywood 827

Proceedings of the Summer Seminar in Fluid Mechanics, edited by P. L. Bhatnagar 827

Proceedings of the 16th Japan National Congress for Applied Mechanics 1966 827

Numerical Methods in Engineering, Volume I, No. 1, edited by O. C. Zienkiewicz and R. H. Gallagher 827

CORRIGENDA 829

INDEX TO VOLUME 37 830

XUM

INDEX

ALDRIDGE, KEITH D. & TOOMRE, ALAR. Axisymmetric intertial oscillations of a fluid in a rotating spherical container, 307

APELT, C. J. Hartmann flow in annular channels. Part 2. Numerical solutions for low to moderate Hartmann numbers, 209

BACH, GLEN G. & LEE, JOHN H. Initial propagation of impulsively generated converging cylindrical and spherical shock waves, 513

BAINES, P. G. & GILL, A. E. On thermohaline convection with linear gradients, 289

BAINES, W. D. & TURNER, J. S. Turbulent buoyant convection from a source in a confined region, 51

BEARMAN, P. W. On vortex shedding from a circular cylinder in the critical Reynolds number régime, 577

BELLHOUSE, B. J. Velocity and pressure distributions in the aortic valve, 587

BLYTHE, P. A. Non-linear wave propagation in a relaxing gas, 31

BLYTHE, P. A., PETTY, D. G., SCHOFIELD, D. A. & WILSON, J. L. On the structure of a class of aerothermodynamic shocks, 349

BREACH, D. R. *See* CHESTER, W. & BREACH, D. R.

BRENNEN, C. The dynamic balances of dissolved air and heat in natural cavity flows, 115

BRENNEN, CHRISTOPHER. A numerical solution of axisymmetric cavity flows, 671

BRODKEY, ROBERT S. *See* CORINO, E. R. & BRODKEY, ROBERT S.

BUSSE, F. H. On Howard's upper bound for heat transport by turbulent convection, 457

BUYEVICH, YU. A., LEONOV, A. I. & SAFRAI, V. M. Variations in filtration velocity due to random large-scale fluctuations of porosity, 371

BUZYNA, GEORGE. *See* WEGENER, PETER P. & BUZYNA, GEORGE

CHAM, T-S. & HEAD, M. R. Turbulent boundary-layer flow on a rotating disk, 129

CHESTER, W. & BREACH, D. R. On the flow past a sphere at low Reynolds number, 751

CORINO, E. R. & BRODKEY, ROBERT S. A visual investigation of the wall region in turbulent flow, 1

COX, R. G. The deformation of a drop in a general time-dependent fluid flow, 601

CROW, S. C. Distortion of sonic bangs by atmospheric turbulence, 529

CSANADY, G. T. *See* KRISHNAPPA, G. & CSANADY, G. T.

FOSTER, THEODORE, D. The effect of initial conditions and lateral boundaries on convection, 81

FUNG, Y. C. *See* LEE, J. S. & FUNG, Y. C.

GILL, A. E. *See* BAINES, P. G. & GILL, A. E.

HEAD, M. R. *See* CHAM, T.-S. & HEAD, M. R.

HELLIWELL, J. B. Self similar piston problems with radiative heat transfer, 497

HUSAR, R. B. *See* SPARROW, E. M. & HUSAR, R. B.

JAFFRIN, M. Y. *See* SHAPIRO, A. H., JAFFRIN, M. Y. & WEINBERG, S. L.

JONES, A. F. & ROSENBLAT, S. The flow induced by torsional oscillations of infinite planes, 337

JOUBERT, P. N. *See* PERRY, A. E., SCHOFIELD, W. H. & JOUBERT, P. N.

KATO, H. & PHILLIPS, O. M. On the penetration of a turbulent layer into stratified fluid, 643

XUM

KRISHNAPPA, G. & CSANADY, G. T. An experimental investigation of the composition of jet noise, 149

KUIKEN, H. K. Free convection at low Reynolds numbers, 785

LAROCK, BRUCE E. Jets from two-dimensional symmetric nozzles of arbitrary shape, 479

LEE, JOHN H. *See* BACH, GLEN G. & LEE, JOHN H.

LEE, J. S. & FUNG, Y. C. Stokes flow around a circular cylindrical post confined between two parallel plates, 657

LEONOV, A. I. *See* BUYEVICH, YU. A., LEONOV, A. I. & SAFRAI, V. M.

LONGUET-HIGGINS, M. S. On the reflexion of wave characteristics from rough surfaces, 231

LONGUET-HIGGINS, M. S. On the trapping of long-period waves round islands, 773

MALCOLM, D. G. Some aspects of turbulence measurement in liquid mercury using cylindrical quartz-insulated hot-film sensors, 701

MICHAEL, D. H. & NOREY, P. W. Particle collision efficiencies for a sphere, 565

MILGRAM, JEROME H. The motion of a fluid in a cylindrical container with free surface following vertical impact, 435

MYSAK, L. A. On the generation of double Kelvin waves, 417

NASH, J. F. The calculation of three-dimensional turbulent boundary layers in incompressible flow, 625

NOREY, P. W. *See* MICHAEL, D. H. & NOREY, P. W.

PARLANCE, JEAN-YVES. Spherical cap bubbles with laminar wakes, 257

PERRY, A. E., SCHOFIELD, W. H. & JOUBERT, P. N. Rough wall turbulent boundary layers, 383

PETERKA, JON A. & RICHARDSON, PETER D. Effects of sound on separated flows, 265

PETTY, D. G. *See* BLYTHE, P. A., PETTY, D. G., SCHOFIELD, D. A. & WILSON, J. L.

PHILLIPS, O. M. *See* KATO, H. & PHILLIPS, O. M.

RHINES, P. B. Slow oscillations in an ocean of varying depth. Part 1. Abrupt topography, 161

RHINES, P. B. Slow oscillations in an ocean of varying depth. Part 2. Islands and seamounts, 191

RICHARDSON, PETER D. *See* PETERKA, JON A. & RICHARDSON, PETER D.

ROSENBLAT, S. *See* JONES, A. F. & ROSENBLAT, S.

SAFRAI, V. M. *See* BUYEVICH, YU. A., LEONOV, A. I. & SAFRAI, V. M.

SAKURAI, TAKEO. Spin down problem of rotating stratified fluid in thermally insulated circular cylinders, 689

SCHOFIELD, D. A. *See* BLYTHE, P. A., PETTY, D. G., SCHOFIELD, D. A. & WILSON, J. L.

SCHOFIELD, W. H. *See* PERRY, A. E., SCHOFIELD, W. H. & JOUBERT, P. N.

SHAPIRO, A. H., JAFFRIN, M. Y. & WEINBERG, S. L. Peristaltic pumping with long wavelengths at low Reynolds number, 799

SPARROW, E. M. & HUSAR, R. B. Longitudinal vortices in natural convection flow on inclined plates, 251

SQUIRE, L. C. A law of the wall for compressible turbulent boundary layers with air injection, 449

SUBRAMANYAM, S. V. A note on the damping and oscillations of a fluid drop moving in another fluid, 715

TOOMRE, ALAR. *See* ALDRIDGE, KEITH D. & TOOMRE, ALAR

TURNER, J. S. *See* BAINES, W. D. & TURNER, J. S.

UNDERWOOD, ROBERT LEIGH. Calculation of incompressible flow past a circular cylinder at moderate Reynolds numbers, 95

WANG, YEE-CHANG. The interaction of internal waves with an unsteady non-uniform current, 761

WEGENER, PETER P. & BUZYNA, GEORGE. Experiments on shock stand-off distance in non-equilibrium flow, 325

WEINBERG, S. L. *See* SHAPIRO, A. H., JAFFRIN, M. Y. & WEINBERG, S. L.

WILLIAMS, GARETH P. Numerical integration of the three-dimensional Navier–Stokes equations for incompressible flow, 727

WILSON, J. L. *See* BLYTHE, P. A., PETTY, D. G., SCHOFIELD, D. A. & WILSON, J. L.

ZDRAVKOVICH, M. M. Smoke observations of the formation of a Kármán vortex street, 491

REVIEWS

Loose Boundary Layers, by A. J. Raudkivi, 207

Mécanique des fluides, by E. A. Brun, A. Martinot-Lagarde and J. Mathieu, 414

SHORTER NOTICES

Introduction to the Hydrodynamics of Porous Bodies, by St I. Gheorgita, 826

Clear Air Turbulence, by N. K. Vinnichenko, N. Z. Pinus, S. M. Schmeter and G. N. Shur, 826

Dynamics of Elastic Containers Partially Filled with Liquid, by I. M. Rapoport, 826

Directory of Fire Research in the United States, 1965–1967, 826

Thermodynamic Tables in S.I. (Metric) Units, by R. W. Haywood, 827

Proceedings of the Summer Seminar in Fluid Mechanics, edited by P. L. Bhatnagar, 827

Proceedings of the 16th Japan National Congress for Applied Mechanics 1966, 827

Numerical Methods in Engineering, Volume I, No. 1, edited by O. C. Zienkiewicz and R. H. Gallagher, 827